4.2.2 WATER RESOURCES

4.2.2.1 Surface Water

For the action alternatives surface water impacts would only occur by discharge of contaminated groundwater. Because the Small Tank Precipitation, Ion Exchange, Solvent Extraction, and Direct Disposal in Grout alternatives would result in radioactive waste being disposed in the Z Area vaults, the potential exists for long-term impacts to groundwater (see Section 4.2.2.2). Contaminants in groundwater could then be transported through the Upper Three Runs Aquifer and the underlying Gordon Aquifer to the seeplines along McQueen Branch and Upper Three Runs, respectively (see Section 4.2.2.2 for a more detailed discussion). The factors that govern the movement of contaminants through groundwater (i.e., the hydraulic conductivity, hydraulic gradient, effective porosity, and dispersion of aquifers in the area) and the processes resulting in attenuation of radiological and nonradiological contaminants (i.e., radioactive decay, ion exchange in the soil, and adsorption to soil particles) would be expected to reduce or mitigate impacts to surface water resources.

As described in Appendix D, DOE used an analysis based on the PORFLOW-3D computer code to model the fate and transport of contaminants in groundwater and subsequent flux (i.e., groundwater discharge at the seepline) to surface waters. The groundwater discharge at the seepline would naturally mix with the stream flow. Assuming that the upstream concentration of all contaminants in surface water is zero, and that no storm runoff is present, the resulting concentration of contaminants in surface water would be the result of the seepline groundwater mixing with uncontaminated surface water. The resulting concentrations in surface water would thus always be less than the groundwater seepline concentrations, due to dilution. The average flows in McQueen Branch and Upper Three Runs at the point of mixing with the groundwater discharge along the seeplines would be on the order of 2 to 3 cubic feet per second and 135 to 150 cubic feet per second, respectively (Parizek and Root 1986).

EPA periodically publishes water quality criteria as concentrations of substances that are known to affect “diversity, productivity, and stability” of aquatic communities including “plankton, fish, shellfish, and wildlife” (EPA 1986, 1999). These recommended criteria provide guidance for state regulatory agencies developing location-specific water quality standards to protect aquatic life (SCDHEC 1999b). Such standards are used in a number of environmental protection programs, including setting discharge limits in NPDES permits. Water quality criteria and standards are generally not legally enforceable; however, NPDES discharge limits based on these criteria and standards are legally binding and are enforced by SCDHEC.

The fate and transport modeling indicates that movement of radiological contaminants from failed vaults to nearby surface waters via groundwater discharge would be minimal. Based on the previous radiological performance assessment (RPA) contaminant screening (WSRC 1992), the radiological contaminants of concern would be carbon-14, selenium-79, technetium-99, tin-126, iodine-129, and cesium-135. Table 4-26 shows maximum radiation doses from all contaminants to humans and corresponding impacts expressed as LCFs from groundwater at the seeplines of McQueen Branch and Upper Three Runs before dilution with surface water. Doses would be low under each action alternative and would be below the drinking water standard of 4 millirem per year (40 CFR 141.16) in all cases. As discussed above, the in-stream concentrations resulting from the mixing of groundwater discharge at the seepline with the upstream flow would result in lower downstream concentrations than shown in Table 4-26. These data represent that point in time.

The 4-millirem-per-year standard applies only to beta-emitting radionuclides but, because the total dose would be less than 4 millirem per year, the standard would be met.

Table 4-26. Maximum dose and health effects from concentrations of radionuclides in groundwater 1 meter and 100 meters downgradient of Z Area vaults and at the seepline.

	Maximum dose							
	Upper Three Runs Aquifer				Gordon Aquifer			
Exposure point	Small Tank Precipitation	Ion Exchange	Solvent Exchange	Direct Disposal in Grout	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
1 meter downgradient								
Total dose (millirem/year)	0.080	0.095	0.074	0.096	0.49	0.58	0.45	0.57
Lifetime LCF[a]	2.8×10^{-6}	3.3×10^{-6}	2.6×10^{-6}	3.4×10^{-6}	1.7×10^{-8}	2.0×10^{-5}	1.6×10^{-5}	2.0×10^{-5}
100 meters downgradient								
Total dose (millirem/year)	0.0068	0.0073	0.0062	0.0079	0.042	0.044	0.038	0.048
Lifetime LCF[a]	2.4×10^{-7}	2.6×10^{-7}	2.2×10^{-7}	2.8×10^{-7}	1.5×10^{-6}	$1.5\times10^{-}$[illegible]	1.3×10^{-6}	1.7×10^{-6}
Seepline								
McQueen Branch								
Maximum dose (millirem/year)	0.0019	0.0020	0.0017	0.0022	NA	NA	NA	NA
Lifetime LCF[a]	6.7×10^{-8}	7.0×10^{-8}	6.0×10^{-8}	7.7×10^{-8}	NA	NA	NA	NA
Upper Three Runs								
Maximum dose (millirem/year)	NA	NA	NA	NA	0.0029	0.0028	0.0025	0.0032
Lifetime LCF[a]	NA	NA	NA	NA	1.0×10^{-7}	6.3×10^{-8}	8.8×10^{-8}	1.1×10^{-7}
Regulatory limit (millirem /year)	4	4	4	4	4	4	4	4

a. Increased probability of an LCF to the exposed individual over a 70-year period.
b. The discharge point for the Upper Three Runs aquifer is the McQueen Branch seepline, and the discharge point for the Gordon aquifer is the Upper Three Runs seepline.
c. Maximum impacts would not occur at the same time due to the different radionuclide transport times to the potential exposure locations.
LCF = latent cancer fatality.

The results of the fate and transport modeling of nonradiological contaminant migration from failed vaults to nearby surface water via groundwater discharge are presented in Table 4-27. Based on the previous RPA contaminant screening (WSRC 1992), the only nonradiological contaminant of concern would be nitrate. The recent modeling results indicate that there would be little difference between the alternatives and that none of the four action alternatives would result in an exceedance of the drinking water criteria for nitrate in the groundwater discharge at the seeplines of McQueen Branch or Upper Three Runs. Concentrations of nitrate at the seeplines would be small (less than 3 milligrams per liter [mg/L]) in all cases. Taking into account the dilution effect of the groundwater discharge mixing with the in-stream flow (assumed to be contaminant-free), the predicted concentrations of nonradiological contaminants would be even lower than those in Table 4-27. Therefore, no health impacts are anticipated from nitrates discharged to surface waters.

Table 4-27. Maximum nonradiological contaminant concentrations (mg/L) in groundwater 1 meter and 100 meters downgradient and at the seepline.

	Maximum concentration							
	Upper Three Runs Aquifer[a]				Gordon Aquifer[b]			
Exposure point/ contaminant	Small Tank Precipitation	Ion Exchange	Solvent Exchange	Direct Disposal in Grout	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
1 meter downgradient								
Nitrate (mg/L)	56	66	51	66	338	395	307	394
100 meters downgradient								
Nitrate (mg/L)	4.8	5.1	4.4	5.6	29	31	26	33
Seepline								
Nitrate (mg/L)	1.4	1.5	1.3	1.6	2.2	2.1	1.9	2.4
EPA MCL (mg/L)	44	44	44	44	44	44	44	44

a. Surfaces at McQueen Branch seepline.
b. Surfaces at Upper Three Runs seepline.
c. Nitrate as total nitrogen.
MCL = maximum contaminant level.

Under the No Action alternative, DOE assumed that only salt waste would be left in the HLW tanks. Failure of the HLW tanks would allow precipitation to collect in the tanks and eventually salt solution could overflow and run off to onsite streams (Upper Three Runs, Fourmile Branch and the Savannah River). The runoff would mix
L6-5 with the stream flow. Assuming that the upstream concentration of all contaminants would be zero and no groundwater infiltration occurred, the concentration of contaminants in Fourmile Branch would be 4.95×10^{-6} curies/liter resulting in a drinking water dose to an individual of 640 millirem per year. Similarly, Upper Three Runs concentrations would be 2.28×10^{-6} curies per liter and the Savannah River concentrations would be 1.12×10^{-7} curies per liter, respectively.

4.2.2.2 Groundwater

Each of the action alternatives proposed in Chapter 2 includes actions that could result in potential long-term impacts to groundwater beneath the Z-Area vaults. Because groundwater is in a state of constant flux, impacts that occur directly below the vaults could propagate to areas hydraulically downgradient of Z Area.

The primary action that would result in long-term impacts to groundwater is failure of the vaults and the generation of contaminated leachate that would enter the vadose zone soils. The contamination has the potential to contaminate groundwater at some point in the future, due to leaching and water-borne transport of contaminants. As described in detail in Appendix D, shallow groundwater beneath the vaults flows to ward McQueen Branch, but also includes a vertical flow component toward deeper aquifers. In the analyzed alternatives, the mobile contaminants that leached from the vault would gradually migrate downward through unsaturated soil to the hydrogeologic units comprising the shallow aquifers underlying the vaults. As described in Section 4.1.2.1, because the vaults will be constructed above the typical elevation of the water table, contaminants released from the vaults would be released into the vadose zone and not directly into the shallow groundwater.

The shallowest hydrogeologic unit affected would be the upper zone of the Upper Three Runs Aquifer, formally known as the Water Table Aquifer (Aadland, Gellici, and Thayer 1995). Hydrogeologic studies and modeling (Flach and Harris 1996) conducted for the area of SRS where S and Z Areas are located, suggest however that flow in the upper zone of the Upper Three Runs Aquifer that originates in the proposed vault disposal area does not outcrop to McQueen Branch. Rather, water in the upper zone would migrate downward into the lower zone of the Upper Three Runs Aquifer (formally known as the Barnwell-McBean Aquifer). Some contaminants would be transported subsequently to the northeast by groundwater flow through the lower zone of the Upper Three Runs Aquifer and discharge at the seepline along McQueen Branch.

The previous modeling results for the General Separations Area (the location of S and Z Areas) (Flach and Harris 1996), also suggested that a portion of the contaminant mass released to the Upper Three Runs Aquifer would migrate downward and then laterally through the Gordon Aquifer to a point of discharge at the seepline along Upper Three Runs. The groundwater flow direction in the Gordon Aquifer is toward the north-northwest.

Summary of Predicted Concentrations

The results of the groundwater fate and transport modeling for radiological and nonradiological contaminants entering the Upper Three Runs and Gordon Aquifers are presented in Tables 4-26 and 4-27. The modeling calculated impacts to each aquifer layer. The results are presented for each alternative for groundwater wells 1 meter and 100 meters downgradient of the vaults and for the seeplines. The specific concentrations for each radiological and nonradiological contaminant for each aquifer layer and each exposure point are presented in Appendix D.

For radiological contaminants, the doses in millirem per year from all radionuclides are considered additive for any given aquifer layer at any exposure point. The concentrations in groundwater from the various aquifers are, however, not additive. The maximum radiation dose (millirem per year), regardless of the aquifer layer is therefore presented in the tables for each exposure point. These data represent the increment in time when the sum of all beta-gamma emitters would be greatest, but not necessarily when all radionuclides are at their maximum concentrations. This method of data presentation shows the overall maximum dose or concentration that could occur at each exposure point. Based on the previous RPA contaminant screening (WSRC 1992), the radiological contaminants of concern in groundwater would be carbon-14, selenium-79, technetium-99, tin-126, iodine-129, and cesium-135.

Based on the previous RPA contaminant screening (WSRC 1992), the only nonradiological contaminant of concern would be nitrate; therefore, only nitrate was modeled. The maximum concentration of nitrate, regardless of time, was determined for each aquifer layer and for each exposure point.

Comparison of Alternatives

The groundwater radiological concentrations (Table 4-26) consistently show that the greatest long-term impacts for beta-gamma emitters at the 100-meter well would occur under the Direct Disposal in Grout or the Ion Exchange alternative, although the differences among alternatives are small. The results also indicate that none of the alternatives would result in an exceedance of the regulatory limit for dose to humans in drinking water (i.e., 4 millirem per year), either at the wells or at the seeplines (i.e., groundwater discharge points). Public health effects are discussed in Section 4.2.5.

The nonradiological results presented in Table 4-27 identify a consistent trend for nitrate at all points of exposure; the highest concentration occurs under the Ion Exchange and Direct Disposal in Grout alternatives, but there are only small differences among alternatives. The data show that nitrate would exceed the maximum contaminant level (MCL) for drinking water 1 meter downgradient of the facility for all alternatives, but would not exceed the 100 meters downgradient of the vaults for any alternatives. The MCL would not be exceeded at the seepline for either aquifer layer.

4.2.3 ECOLOGICAL RESOURCES

This section presents an evaluation of the potential long-term impacts of salt processing alternatives to ecological receptors. DOE assessed the potential risks to ecological receptors at the seeplines of McQueen Branch (a tributary of Upper Three Runs near Z Area) and Upper Three Runs.

Groundwater-to-surface water discharge of contaminants was the only long-term migration pathway evaluated because the disposal vaults will be several meters underground, precluding overland runoff of contaminants and associated terrestrial risks. The vaults would have concrete roofs and be capped with clay and gravel. This would provide an impervious layer for deep plant roots. As a result, only risks to aquatic or semi-aquatic biota were considered possible. The habitat in the vicinity of the seeplines is bottomland (riparian) hardwood forest along the channels of McQueen Branch and Upper Three Runs. Upslope of the floodplain, the forest is a mixture of pine and hardwood.

The Small Tank Precipitation, Ion Exchange, Solvent Extraction, and Direct Disposal in Grout alternatives were assessed for their potential long-term ecological impacts. Modeling of groundwater-to-surface water migration of contaminants from the disposal vaults indicated that nitrate was the only nonradiological chemical that would reach McQueen Branch and Upper Three Runs, and that carbon-14, selenium-79, technetium-99, tin-126, iodine-129, and cesium-135 were the radionuclides that would reach the two streams. The model generated concentrations of these contaminants in the groundwater at the seeplines.

4.2.3.1 <u>Radiological Contaminants</u>

The Oak Ridge National Laboratory (ORNL) has developed screening guidelines for the protection of aquatic organisms from radiological chemicals in surface water (Bechtel Jacobs Company 1998). These guidelines were developed by back-calculating the DOE Order 5400.5 dose rate limit for aquatic biota of 1.0 rad per day (rad/d) to obtain corresponding concentrations of radionuclides in surface water. These guidelines can then be compared to ambient concentrations to assess potential risks to aquatic biota. The guidelines are in picocuries per liter (pCi/L) and were developed separately for small fish and large fish. All guidelines include exposures from parent isotopes and all short-lived daughter products. They also include exposures from all major alpha, beta, and gamma emissions for each isotope. It should be noted that ORNL developed its guidelines for radionuclides of concern at the Oak Ridge Reservation. No similar values have been calculated for SRS. However, the ORNL values were derived using generic data and are based on types of fish that could occur on SRS. The groundwater chemical data for this SEIS were modeled for thousands of years after disposal and, therefore, the isotopes that comprise the data are not generally in agreement with ORNL's (i.e., in this analysis, credit was taken for radioactive decay). Only a guideline for technetium-99 was available.

The predicted radiological concentrations in groundwater at the McQueen Branch and Upper Three Runs seeplines are presented in Table 4-28 for each of the four action alternatives. The concentrations of technetium-99 were orders of magnitude lower than the ORNL guideline. Again, no ORNL guidelines were available for the other elements (their particular isotopes). However, a cesium-137 surrogate value of 6.19×10^3 pCi/L can be used to assess risks from the elements other than technetium-99. This value generates an acceptable dose of 1 rad/day. Cesium-137 has a higher energy emitted per day than the other radionuclides in the seepwater. Because the surrogate guideline concentration is orders of magnitude higher than all those of the detected radionuclides in the seepwater, it can be inferred that the risks from those elements would be much lower. Because the maximum radiological concentrations predicted for McQueen Branch and Upper Three Runs are all far below TC

Table 4-28. Maximum concentrations of radiological contaminants in seepline groundwater compared to ORNL screening guidelines (pCi/L).

		Small Tank Precipitation		Ion Exchange		Solvent Extraction		Direct Disposal in Grout	
Contaminant	ORNL guideline Small/Large Fish[a]	McQueen Branch (Upper Three Runs Aquifer)	Upper Three Runs (Gordon Aquifer)	McQueen Branch (Upper Three Runs Aquifer)	Upper Three Runs (Gordon Aquifer)	McQueen Branch (Upper Three Runs Aquifer)	Upper Three Runs (Gordon Aquifer)	McQueen Branch (Upper Three Runs Aquifer)	Upper Three Runs (Gordon Aquifer)
Carbon-14	NA[b]	1.9×10^{-6}	2.0×10^{-6}	2.1×10^{-6}	1.9×10^{-6}	1.8×10^{-6}	1.7×10^{-6}	2.2×10^{-6}	2.1×10^{-6}
Selenium-79	NA[b]	0.16	0.23	0.17	0.23	0.15	0.20	0.19	0.25
Technetium-99	1.94×10^{6}/ 1.94×10^{6}	0.42	0.66	0.44	0.64	0.38	0.58	0.48	0.72
Tin-126	NA[b]	5.7×10^{-5}	3.9×10^{-5}	6.1×10^{-5}	3.9×10^{-5}	5.2×10^{-4}	3.5×10^{-5}	6.6×10^{-5}	4.3×10^{-5}
Iodine-129	NA[b]	0.0028	0.0045	0.0029	0.0044	0.0025	0.0039	0.0032	0.0049
Cesium-135	7,720/6,190	9.8×10^{-7}	1.5×10^{-6}	1.0×10^{-6}	1.5×10^{-6}	8.9×10^{-7}	1.3×10^{-6}	0.012	0.017

a. Cesium-137 is used as a surrogate value for cesium-135. Cesium-137 has a higher decay energy than cesium-135. Therefore, this is a conservative estimate of the guideline for cesium-135.
b. Specific guidelines for these radionuclides are not available. However, because cesium accumulates in biological tissues and because cesium-137 has a higher decay energy than any of the other radionuclides listed, guidelines for these radionuclides are unlikely to be smaller than the guideline for cesium-137.

this surrogate guideline, it can be concluded that potential risks to aquatic biota in McQueen Branch and Upper Three Runs from radionuclides in seepwater would be very low.

4.2.3.2 Nonradiological Contaminants

Nitrate is considered to be essentially non-toxic to fish and wildlife, and is important as a plant nutrient in aquatic systems (Wetzel 1983).

Nitrates are generally considered to be a potential human health hazard at high concentrations in drinking water because they are reduced to nitrites in the digestive system (EPA 1986). Nitrites are capable of oxidizing hemoglobin to produce methemoglobin, which is incapable of transporting oxygen (EPA 1986). However, in well-oxygenated aquatic systems, nitrite is typically oxidized to nitrate.

The relatively low ecotoxicity from nitrates is reflected in the lack of surface water screening levels and criteria. EPA (1986) points out that concentrations of nitrate or nitrite with toxic effects on fish could "rarely occur in nature" and, therefore, "restrictive criteria are not recommended". No Federal ambient water quality criteria based on protection of aquatic organisms are available for nitrates (or nitrites) (EPA 1999). Nevertheless, some guidelines for nitrate/nitrite toxicity are available. EPA (1986) concludes that (1) concentrations of nitrate at or below 90 mg/L will have no adverse effects on warmwater fishes, (2) nitrite at or below 5 mg/L would be protective of most warmwater fishes, and (3) nitrite at or below 0.06 mg/L should be protective of salmonid fishes (no salmonid fishes are present on SRS). The Canadian Council of Ministers of the Environment (CCME) presents a surface water guideline protective of aquatic organisms of 0.06 mg/L (Environment Canada 1998). In the past, DOE has used an MCL of 10 mg/L as a surrogate protective concentration for semi-aquatic wildlife, such as mink (DOE 1997b).

Generally speaking, the only effects of elevated nitrate concentrations in streams and reservoirs are the fertilization of algae and macrophytes and the hastening of eutrophication. This occurs mainly when significantly increased nitrate inputs and inputs of other nutrients, mainly phosphorous, continue over a long period of time (Wetzel 1983). The concentrations of nitrate in groundwater at the McQueen Branch and Upper Three Runs seeplines are presented in Table 4-29 for each of the four action alternatives. On the whole, the predicted concentrations in seepwater for all four action alternatives exceeded the EPA nitrite guideline for protection of coldwater fishes and the CCME nitrite guideline for protection of aquatic biota. The concentrations were comparable to the EPA nitrite guideline for protection of warmwater fishes and were an order of magnitude or more lower than the EPA nitrate no-adverse-effects guideline for warmwater fishes. They also were less than the human health nitrate MCL. It should be noted that guidelines for coldwater fishes are conservative because they are usually based on toxicity data for salmonids, which are generally more sensitive to contaminants than warmwater fishes (Mayer and Ellersieck 1986).

If the ratio of nitrates to nitrites introduced from the alternatives was lower, or the introduced nitrate was transformed to nitrite in appreciable quantities, substantive risks could potentially be present. However, EPA (1986) states that, in oxygenated natural water systems, nitrite is rapidly oxidized to nitrate. Upper Three Runs tends to be well oxygenated (Halverson et al. 1997).

More importantly, the assessment of risk to ecological receptors was performed on groundwater at the seepline and, hence, did not account for dilution by stream volumes. After dilution, the concentration of nitrate (and nitrite) would likely be much lower, probably by orders of magnitude.

Toxicity data for semi-aquatic receptors (e.g., mink) are scarce for nitrate, reflecting its relatively low ecotoxicity. Only one study of the effects of nitrate on mammals that applied to ecological risk considerations could be located.

Table 4-29. Maximum concentrations of nitrate in seepline groundwater compared to ecotoxicity guidelines (mg/L).

	Alternative (mg/L)				Ecotoxicity guideline (mg/L)				
Aquifer	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout	No-adverse-effects on warmwater fishes (nitrate as nitrogen)[a]	Protection of warmwater fishes (nitrite as nitrogen)[a]	Protection of cold-water fishes (nitrite as nitrogen)[a]	CCME guideline for protection of aquatic biota (nitrite as nitrogen)[b]	MCL (nitrate as nitrogen)[c]
McQueen Branch (Upper Three Runs Aquifer)	1.4	1.5	1.3	1.6	90	5	0.06	0.06	10
Upper Three Runs (Gordon Aquifer)	2.2	2.1	1.9	2.4	90	5	0.06	0.06	10

a. EPA (1986).
b. Environment Canada (1998).
c. Maximum Contaminant Level (MCL) for drinking water (EPA 1999).

The study involved the effects of potassium nitrate on guinea pigs, using oral ingestion of water as the exposure medium (ORNL 1996). No adverse effects were observed at a dose of 507 milligrams per kilogram (mg/kg) of body weight per day (mg/kg/day). A reduction in the number of live births was observed at 1,130 mg/ kg/day. ORNL (1996) extrapolated toxicity and dose concentration data from this study to determine potentially toxic concentrations in various media to wildlife species. Based on the ORNL study, nitrate concentrations of at least 6,341 and 4,932 mg/L in surface water would be necessary to produce toxic effects for the short-tailed shrew and mink, respectively. The con-centrations are several orders of magnitude higher than the maximum modeled concentrations presented in Table 4-29. EPA (1986) does not indicate that nitrate bioaccumulates and, therefore, concentrations in the prey or forage of semi-aquatic wildlife would likely be low.

For these reasons, the potential risks to aquatic and semi-aquatic biota in McQueen Branch and Upper Three Runs from nitrate would be low for all alternatives.

TC

The No Action alternative would have severe adverse impacts on the ecological resources in one area of the tank farms.

4.2.4 LAND USE

Long-term impacts from saltstone disposal vaults would not affect proposed SRS future land use. However, the presence of 13 to 16 low-level radioactive vaults in Z Area (see Table 4-1) would limit any other use for as long as the vaults remained, a period of time modeled to 10,000 years in this analysis.

L6-60

The tank farm areas are already designated to remain an industrialized zone. In principle, industrial zones are ones in which the facilities pose either a potentially significant nuclear or non-nuclear hazard to employees or the general public. Because of the contamination under the No Action alternative, future land use at SRS tank farms would not support human or ecological habitats under this scenario.

4.2.5 PUBLIC HEALTH

This section presents the potential impacts on human health from contaminants in the saltstone at some point after the period of institutional control of Z Area. To determine the long-term impacts, DOE evaluated data for Z Area, including the following:

- Expected source inventory that would be present in the saltstone
- Existing technical information on geological and hydrogeological parameters in the vicinity of Z Area
- Arrangement of the saltstone vaults within the stratigraphy
- Actions to be completed under each of the alternatives.

In its evaluation, DOE reviewed the methodology and conclusions contained in the *Radiological Performance Assessment for the Z-Area Saltstone Facility* (WSRC 1992) to determine what changes in the RPA analysis, if any, would result from implementing any of the salt processing alternatives. (The RPA was done for saltstone that would have resulted from the In-Tank Precipitation process.) Based on its review, DOE believes the exposure pathway methodology in the RPA is technically valid. DOE has modified certain input parameters to represent the alternatives. Therefore, DOE believes this modeling is valid for evaluating long term impacts. See Appendix D for additional details.

The RPA considers multiple routes of exposure for humans in the future. Z Area is zoned as an industrial area, and DOE does not expect that any public access to Z Area would be allowed. However, for purposes of analysis, DOE assumed that people would have access to the land beginning 100 years after the last vault was closed. The RPA considered multiple routes of exposure for humans following a 100-year period of institutional control and determined that two scenarios, an agricultural

L8-7 scenario and a residential scenario, would have the greatest potential for exposing a hypothetical individual to saltstone contaminants. Impacts on trespassers were not considered for the action alternatives because the impacts on trespassers would be small due to much shorter exposure times relative to the agricultural scenario. The assumptions of the two scenarios are described below:

- An agricultural scenario, in which the individual unknowingly farms and constructs a home on the soil above the saltstone vaults. In this scenario, the individual is assumed to derive half of his vegetable consumption from a garden planted in contaminated soil located over the vaults. The time spent gardening is assumed to be short compared to the amount of time spent indoors or farming. Only potential impacts from external radiation, inhalation, incidental soil ingestion, and vegetable ingestion are calculated for indoor residence and outdoor gardening activities. Since the farming activities would occur over a widespread area that would include uncontaminated and undisturbed soil not subject to irrigation with contaminated water, the meat and milk pathways would not contribute significantly to the individual's dose. Because of DOE's expectation that the saltstone would remain relatively intact for an extended period of time, DOE does not believe this scenario could be reasonable until approximately 10,000 years post-closure because, at least until that time, the individual could identify that he was digging through a cementitious material. However, for conservatism, DOE has calculated the impacts of the agricultural scenario at 1,000 years post-closure. This scenario includes the 1,000-year residential scenario described below.

- A residential scenario, in which the individual constructs and lives in a permanent residence on the vaults. This scenario analyzes two options: construction at 100 years and at 1,000 years. Under the first option, a sufficient layer of soil would cover the still-intact vaults so that the individual would not know that the residence was constructed on the vaults. Under the second option, the saltstone is assumed to have been exposed and weathered sufficiently so that a person could build a home directly on a degraded vault without being aware of the saltstone.

Radiological Contaminants

In addition to these scenarios and options, the RPA also determined the impacts from consuming water from a well drilled 100 meters from the saltstone vaults after the period of institutional control. The original analysis considered the two uppermost aquifers underneath the saltstone facility and determined the concentrations downgradient of the vaults.

Using this information from the RPA, DOE calculated new results for the groundwater concentrations and the exposure scenarios. First, DOE used the engineering data developed during the alternative development process to determine how the saltstone composition would differ for the alternatives analyzed in this SEIS, as compared to the composition of the saltstone analyzed in the original RPA. Second, DOE determined how the new saltstone compositions (including concentrations of contaminants) affected the results in the original RPA and used that information as the basis to determine results for the analyzed alternatives in this SEIS. For those issues that the RPA did not address (such as direct disposal of cesium in grout), DOE performed the necessary original calculations to account for the newer information. A detailed discussion of DOE's methodology is contained in Appendix D.

Table 4-30 shows the calculated groundwater concentrations and radiation doses from the exposure scenarios. DOE compared groundwater results to the regulatory limits for drinking water specified in 40 CFR 141. The applicable drinking water standards for radionuclides are 4 millirem per year for beta/gamma-emitting radionuclides and

Table 4-30. Summary comparison of long-term human exposure scenarios and health effects.

Parameter	No Action	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Nitrate concentration at 100-meter well (mg/L)[a]	NA	29	31	26	33
Radiation dose (millirem per year) from 100-meter well	640[b]	0.042	0.044	0.038	0.048
LCF from 100-meter well[c]	0.022[b]	1.5×10^{-6}	1.5×10^{-6}	1.3×10^{-6}	1.7×10^{-6}
Radiation dose from Agricultural Scenario (millirem per year)	NA	110	130	110	140
LCF from Agricultural Scenario[c]	NA	3.9×10^{-3}	4.6×10^{-3}	3.9×10^{-3}	4.9×10^{-3}
Radiation dose from Residential Scenario at 100 years post-closure (millirem per year)[c]	2,320,000[d]	0.11	0.13	0.1	1,200[e]
LCF from Residential Scenario at 100 years post-closure[c]	1.16[f]	3.9×10^{-6}	4.6×10^{-6}	3.5×10^{-6}	4.2×10^{-2}
Radiation dose from Residential Scenario at 1,000 years post-closure[g] (millirem per year)[g]	NA	69	80	65	85
LCF from Residential Scenario at 1,000 years post-closure[c]	NA	2.4×10^{-3}	2.8×10^{-3}	2.3×10^{-3}	3.0×10^{-3}

L6-32

a. Nitrate MCL is 10 mg/L (EPA 1999).
b. Based on consumption of contaminated surface water in Fourmile Branch.
c. Health effects are expressed as lifetime (70-year) individual probability of an LCF.
d. Based on external radiation in the area of the tank farm.
e. The external dose for direct disposal in grout alternative in the 100-year scenario is primarily due to cesium-137 (half-life 30 years). For all other action alternatives and scenarios, the external dose is primarily due to the isotopes with long half-lives. L4-10
f. Probability of an LCF provided for comparison. The external radiation dose from No Action would result in prompt fatalities.
g. External radiation doses at 1,000 years post-closure are higher than doses at 100 years post-closure because a layer of soil that provides shielding is assumed to be present in the 100 year scenario, but is assumed to be absent in the 1,000 year scenario.

NA = not applicable.

15 pCi/L for alpha-emitting radionuclides. The RPA analyses indicated that alpha-emitting radionuclides would not be transported from the saltstone vaults except in minute quantities, and DOE therefore excluded them from the impacts analysis. For nonradiological constituents (primarily nitrate), DOE compared the water concentrations directly to the concentrations listed as MCLs in 40 CFR 141.

The differences in calculated concentrations and doses among the action alternatives are primarily a function of the differences in composition of the saltstones. The Small Tank Precipitation alternative would produce a saltstone very similar to that analyzed in the RPA, and the results for this alternative (in Table 4-30) are therefore consistent with the results in the RPA. The Ion Exchange alternative would result in a salt solution with slightly higher contaminant concentrations, resulting in higher contaminant concentrations in saltstone and associated greater impacts. Similarly, the Solvent Extraction salt solution has slightly lower concentrations.

The Direct Disposal in Grout alternative would result in a salt solution with slightly higher concentrations for most constituents than the other alternatives, but with essentially all of the cesium. Cesium-137 has a relatively short half-life (approximately 30 years), so the cesium-137 concentration at the end of 100 years would be decreased by a factor of about 10, with subsequent decreases as time elapses. Therefore, for most of the scenarios in Table 4-30, the impacts of Direct Disposal in Grout are comparable to those of the other alternatives. However, for the residential scenario that assumes construction at 100 years directly on top of the saltstone facility, radioactive cesium would still be present in quantities sufficient to produce a dose noticeably higher than the other alternatives. Because the second residential scenario assumes construction at 1,000 years, the radioactive cesium would have undergone approximately 30 half-lives, resulting in a greatly decreased dose contribution from that radionuclide (however, the longer-lived cesium-135 isotope would still be present).

The maximum doses from the drinking water, agricultural, and 100-year residential scenarios are not expected to occur concurrently, although the agricultural scenario values in the table include the 1,000-year residential scenario contribution, as discussed above. Therefore, it is not appropriate to add the doses from these scenarios.

As shown in Table 4-30, the 1,000-year residential scenario doses for all four action alternatives are similar and would be below the 100-millirem-per-year public dose limit. They range from as low as approximately 65 millirem per year to as high as 85 millirem per year. Doses for the agricultural scenario are similar, but exceed the 100-millirem-per-year public dose limit. Doses for the agricultural scenario would range from 110 to 140 millirem per year. For the 100-year residential scenario, the dose would be highest for the Direct Disposal in Grout alternative (1,200 millirem per year) and would exceed the 100-millirem-per-year public dose limit. The 100-year residential scenario doses for the other three action alternatives would be much smaller and would not exceed 0.13 millirem per year.

As discussed in Section 4.1.4.1, DOE adopted a dose-to-risk conversion factor of 0.0005 LCFs per person-rem to estimate the probability of an individual developing a fatal cancer from the calculated radiation exposure. Because estimation of future populations is very speculative, DOE based the analysis of each scenario on an individual with a 70-year life span. As shown in Table 4-30, under the action alternatives, the probability of an LCF resulting from the long-term exposure scenarios is low. Therefore, DOE expects no adverse health impacts due to these radiation exposures.

As discussed above for the No Action alternative, an individual consuming 2 liters per day of water from Fourmile Branch would receive a dose of 640 millirem per year. This dose is more than 160 times the drinking water regulatory limit of 4 millirem per year and would result in a 2.2 percent incremental increase in the probability of contracting a latent cancer fatality from a 70-year lifetime exposure. While a 2.2 percent increase is low, the probability of contracting an LCF under the No Action alternative is about 13,000 times greater than that of any of the action alternatives. L6-5 L6-51

For the No Action alternative, an individual living in the tank farm area would receive an external dose of about 2,320,000 millirem in the first year following the event, which would result in a prompt fatality.

References

Aadland, R. K., J. A. Gellici, and P. A. Thayer, 1995, *Hydrogeologic Framework of West-Central South Carolina,* Report 5, State of South Carolina Department of Natural Resources – Water Resources Division, Columbia, South Carolina.

Arnette, M. W. and A. R. Mamatey, 1998a, *Savannah River Site Environmental Data for 1997,* WSRC-TR-97-00324, Westinghouse Savannah River Company, Aiken, South Carolina.

Arnette, M. W. and A. R. Mamatey, 1998b, *Savannah River Site Environmental Data for 1997,* WSRC-TR-97-00322, Westinghouse Savannah River Company, Aiken, South Carolina.

ATSDR (Agency for Toxic Substances and Disease Registry), 1988, "Public Health Statement - Beryllium," Division of Toxicology, Atlanta, Georgia. Available at http://www.atsdr.cdc.gov/ToxProfiles/PHS/Beryllium.1988.html. Accessed March 8, 2001.

Bauer, L. R., 1991, *Modeling Chronic Atmospheric Releases at the SRS: Evaluation and Verification of XOQDOQ,* WSRC-RP-91-0320, Savannah River Laboratory, Aiken, South Carolina.

Bechtel Jacobs Company, 1998, Radiological Benchmarks for Screening Contaminants of Potential Concern for Effects on Aquatic Biota at Oak Ridge National Laboratory, Oak Ridge, Tennessee, BJC-OR-80, Oak Ridge, Tennessee.

BTS (Bureau of Transportation Statistics), 1998, "Table 3-20," *The National Transportation Statistics for 1998*, U.S. Department of Transportation, Washington, D.C. Available at http://www.bts.gov/btsprod1nts/chp3v.html. Accessed June 16, 2000.

Cappucci, A. J., S. A. Bates, and D. E. Welliver, 1999, *Determination of Accident Sequence, Frequency, and Source Term Selections for the Salt Disposition Supplemental Environmental Impact Statement,* S-CLC-G-00187, Rev. A, Westinghouse Safety Management Solutions, Aiken, South Carolina.

Carter, W. P. L., 1994, "Development of Ozone Reactivity Scales for Volatile Organic Compounds," *Journal of the Air and Waste Management Association*, 44: 881-899. Available at ftp://ftp.cert.ucr.edu/pub/carter/pubs/reactpap.pdf. Accessed February 26, 2001.

CEQ (Council on Environmental Quality), 1997, *Environmental Justice Guidance under the National Environmental Policy Act,* Executive Office of the President, Washington, D.C.

DOE (U.S. Department of Energy), 1980, *Final Environmental Impact Statement (Supplement to ERDA-1537, September 1977) Waste Management Operational Double-Shell Tanks for Defense High-Level Radioactive Waste Storage*, DOE/EIS-0062, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1982, *Final Environmental Impact Statement, Defense Waste Processing Facility,* DOE/EIS-0082, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1993*, Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements,* Office of Environment, Safety, and Health (EH-25), Washington, D.C.

DOE (U.S. Department of Energy), 1994, *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility,* DOE/EIS-0082S, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1995, *Final Environmental Impact Statement for the Interim Management of Nuclear Materials,* DOE/EIS-0220, Savannah River Operations Office, Savannah River Site, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1997a, *Final Environmental Impact Statement for the Shutdown of the River Water System at the Savannah River Site*, DOE/EIS-0268, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1997b, *Industrial Wastewater Closure Module for the High-Level Waste Tank 17 System,* Construction Permit Number 17,424-lW, Rev. 2, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1998, *Savannah River Site Future Use Plan,* Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 1999, *Accelerator Production of Tritium for the Savannah River Site Final Environmental Impact Statement,* DOE/EIS-0270, Savannah River Operations Office, Aiken, South Carolina.

DOE (U.S. Department of Energy), 2000a, *Guidance on Clean Air Act General Conformity Requirements and the National Environmental Policy Act Process,* Office of Environment, Safety, and Health, Washington, D.C.

DOE (U.S. Department of Energy), 2000b, "Savannah River Operations Injury and Illness Experience – By Organization for 1995 through 1999." Office of Environment, Safety, and Health. Available at http://tis.eh.doe.gov/cairs/cairs/fieldof/fomain.html. Accessed September 28, 2000.

DOE (U.S. Department of Energy), 2000c, *Draft Guidance on Incorporating Environmental Justice Considerations into the Department of Energy's National Environmental Policy Act Process,* Office of NEPA Policy and Assistance, Washington, D.C.

DOE (U.S. Department of Energy), 2000d, *Discussion Draft, Savannah River Site Long-Range Comprehensive Plan*, Savannah River Operations Office, Aiken, South Carolina. Available at http://www.srs.gov/general/srinfo/compplan.pdf. Accessed March 9, 2001.

DOE (U.S. Department of Energy), 2000e, *High-Level Waste Tank Closure Draft Environmental Impact Statement*, DOE/EIS-0303D, Savannah River Operations Office, Aiken, South Carolina.

Eckerman, K. F., F. J. Congel, A. K. Roecklein, and W. J. Pasciak, 1980, *Users Guide to GASPAR Code,* NUREG-0597, U.S. Nuclear Regulatory Commission, Washington, D.C.

Environment Canada, 1998, *Summary of Canadian Water Quality Guidelines for the Protection of Aquatic Life*. Interim draft guidelines transmitted on April 20, 1998 to G. P. Friday, Westinghouse Savannah River Company, from Robert Kent, Head Water Quality Guidelines and Assessments Section, Guidelines and Standards Division.

EPA (U.S. Environmental Protection Agency), 1986, *Quality Criteria for Water,* EPA 440/5-86-001, Office of Water, Washington, D.C.

EPA (U.S. Environmental Protection Agency), 1992, *Fugitive Dust Model (FDM), Region 10, Seattle, Washington.* Available at http://epa.gov/ttn/scram. Accessed May 21, 2001.

EPA (U.S. Environmental Protection Agency), 1995*, User's Guide for the Industrial Source Complex (ISC3) Dispersion Models,* EPA-454/B-95-003a, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

EPA (U.S. Environmental Protection Agency), 1998, "Integrated Risk Information System (IRIS) Database." Available at http://www.epa.gov/ngispgm3/iris/index.html. Accessed March 7, 2001.

EPA (U.S. Environmental Protection Agency), 1999, *National Recommended Water Quality Criteria — Correction,* EPA 822-Z99-001, Office of Water, Washington, D.C.

EPA (U.S. Environmental Protection Agency), 2000, "National Air Pollutant Emission Trends: 1900-1998," EPA 454/R-00-002, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. Available at www.epa.gov/ttn/chief/trends/trends98/trends98.pdf. Accessed February 26, 2001.

EPA (U.S. Environmental Protection Agency), 2001, "Aerometric Information Retrieval System (AIRS) Database." Available at http://www.epa.gov/airsdata. Accessed February 26, 2001.

Flach, G. P., and M. K. Harris, 1996, *Integrated Hydrogeological Model of the General Separations Area (U), Volume 2: Groundwater Flow Model,* WSRC-TR-96-0399, Westinghouse Savannah River Company, Aiken, South Carolina.

Golden, J., R. R. Ouellette, S. Saari, P. N. Cheremisinoff, 1980, *Environmental Impact Data Book,* Ann Arbor Science Publishers, Ann Arbor, Michigan.

Halverson, N. V., L. D. Wike, K. K. Patterson, J. A. Bowers, A. L. Bryan, K. F. Chen, C. L. Cummins, B. R. del Carmen, K. L. Dixon, D. L. Dunn, G. P. Friday, J. E. Irwin, R K Kolka, H. E. Mackey, Jr., J. J. Mayer, E. A. Nelson, M. H. Paller, V. A. Rogers, W. L. Specht, H M Westbury, and E. W. Wilde, 1997, *SRS Ecology Environmental Information Document*, WSRC-TR-97-0223, Westinghouse Savannah River Company, Aiken, South Carolina.

Halverson, N. V., 1999, *Revised Cumulative Impacts Data,* Interoffice memorandum to C. B. Shedrow, SRT-EST-99-0328, Rev. 1, Westinghouse Savannah River Company, Aiken, South Carolina.

Hamby, D. M., 1992, *Verification of GASPAR Dose Assessment Module Used in MAXIGASP and POPGASP,* WSRC-RP-92-418, Savannah River Laboratory, Aiken, South Carolina.

Hunter, C. H., 2000, *Non-Radiological Air Quality Modeling for the High-Level Waste Salt Disposition Environmental Impact Statement,* WSRC-TR-99-00403, Rev. 1, Westinghouse Savannah River Company, Aiken, South Carolina.

Mayer, F. L. and M. R. Ellersieck, 1986, *Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals,* United States Fish and Wildlife Service, Resource Pub. 160, Washington, D.C.

National Jewish Medical and Research Center, 2001, "Facts about Beryllium Disease." Available at http://www.nationaljewish.org/medfacts/beryllium_medfact.html. Accessed February 13, 2001.

NCRP (National Council on Radiation Protection and Measurements), 1993, *Limitations of Exposure to Ionizing Radiation,* Report No. 116, Washington, D.C.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 20, Appendix I,* Rev. 1, Washington, D.C.

NIOSH (National Institute for Occupational Safety and Health), 1986, *Occupational Respiratory Diseases*, Publication No. 86-102, U.S. Department of Health and Human Services, Washington D.C. Available at http://www.cdc.gov/niosh/86-102.html. Accessed March 7, 2001.

ORNL (Oak Ridge National Laboratory), 1996, *Toxicological Benchmarks for Wildlife: 1996 Revision,* ES/ER/TM-86/R3, Health Sciences Research Division, Oak Ridge, Tennessee.

Parizek, R. R. and R. W. Root, 1986, *Development of a Ground Water Velocity Model for the Radioactive Waste Management Facility,* Savannah River Plant, Aiken, South Carolina.

Pike, J. A., 2000, *Preliminary Source Term and Emissions Data for Salt Processing Environmental Impact Statement,* HLW-SDT-0161, Rev. 5, Westinghouse Savannah River Company, Aiken, South Carolina.

Sagendorf, J. F., J. T. Croll, and W. F. Sandusky, 1976, *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations,* NUREG/CR--2919, U.S. Nuclear Regulatory Commission, Washington, D.C.

Sagendorf, J. F., J. T. Croll, and W. F. Sandusky, 1982, *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations. Final Report.* NUREG/CR-2919, U.S. Nuclear Regulatory Commission, Washington, D.C.

Saricks, C. L. and M. M. Tompkins, 1999, *State-Level Accident Rates of Surface Freight Transportation: A Re-examination,* ANL/ESD/TM-150*,* The Center for Transportation Research, Energy Systems Division, Argonne National Laboratory, Argonne, Illinois.

SCDHEC (South Carolina Department of Health and Environmental Control), 1996, "General Permit for Land Disturbing/Construction Activities SRS/Aiken County," Letter to Westinghouse Savannah River Company, December 11.

SCDHEC (South Carolina Department of Health and Environmental Control), 1999a, *Water Use Report—Savannah River Site 1998*, Permit and Data Administration Section, Columbia, South Carolina.

SCDHEC (South Carolina Department of Health and Environmental Control), 1999b, Water Classifications and Standards (R.61-68) and Classified Waters (R.61-69), Bureau of Water, Columbia, South Carolina.

Schafner, J. R., Westinghouse Savannah River Company, 2001, "Wastewater Treatment Capacities and Utilization," Interoffice memorandum to J. Zimmerly, Tetra Tech NUS, Aiken, South Carolina, February 20.

Sessions, J., 1999, Westinghouse Savannah River Company, "Answer to phone questions," email to B. Bradford, Tetra Tech NUS, Aiken, South Carolina, August 23.

Simpkins, A. A., 1995a, *Verification of AXAIRQ,* WSRC-RP-95-708, Savannah River Technology Center, Aiken, South Carolina.

Simpkins, A. A., 1995b, *AXAIRQ User's Manual,* WSRC-RP-95-709, Savannah River Technology Center, Aiken, South Carolina.

Simpkins, A. A., 1999, *Salt Disposition Facility EIS Routine Releases Environmental Dosimetry Calculations,* SRT-EST-99-310, Savannah River Technology Center, Aiken, South Carolina.

Simpkins, A. A., 2000a, *Salt Disposition Facility EIS Routine Release Worker Environmental Dosimetry Calculations,* SRT-EST-2000-236, Savannah River Technology Center, Aiken, South Carolina.

Simpkins, A. A., 2000b, *Salt Disposition Facility EIS Routine Release Worker Environmental Dosimetry Calculations,* SRT-EST-2000-240, Savannah River Technology Center, Aiken, South Carolina.

Wetzel, R. G., 1983, *Limnology,* McGraw-Hill Books, Philadelphia, Pennsylvania.

WSRC (Westinghouse Savannah River Company), 1992, *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility,* WSRC-RP-92-1360, Prepared by Martin Marietta Energy Systems, Inc.

WSRC (Westinghouse Savannah River Company), 1993, *Storm Water Pollution Prevention Plan,* WSRC-IM-93-28, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1996, *Site Infrastructure,* Site Utilities Department, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1998a, *Life Cycle Cost Estimate Bases, Assumptions, and Results,* WSRC-RP-98-00167, Rev. 1, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company) 1998b, *High-Level Waste Salt Disposition Engineering Team Final Report,* WSRC-RP-98-00170, Rev. 0, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1999a, *SRTC Non-Rad Air Emissions Data Needs for Construction Activities, DOE/EIS-0082-S2,* HLW-SDT-99-0151, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1999b, *Response to Data Call for Salt Disposition Alternatives at the Savannah River Site, DOE/EIS-0082-S2,* HLW-SDT-99-0181, Rev. 0, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1999c, *Radiological Performance Indicators, 4th Quarter CY 1998,* ESH-HPT-99-0017, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1999d, *High-Level Waste Tank Space Management Team Final Report,* WSRC-RP-99-00005, Rev. 0, Aiken, South Carolina.

WSRC (Westinghouse Savannah River Company), 1999e, *SEIS DOE/EIS-0082-S2,* "Response to Supplemental Data Needs", Interoffice memorandum from J. Sessions to C. B. Shedrow, August 18.

WSRC (Westinghouse Savannah River Company), 2000a, *Data Response: Supplemental Environmental Impact Statement for High-Level Waste Salt Disposition,* ESH-EAP-2000-0011, Aiken, South Carolina, June 12.

WSRC (Westinghouse Savannah River Company), 2000b, *WSRC Response to TtNUS Supplemental Data Call,* HLW-SDT-2000-00263, Rev. 0, Aiken, South Carolina.